TP, TPD

Installation and operating instructions



TP, TPD

Declaration of conformity

GB: EC declaration of conformity

We, Grundfos, declare under our sole responsibility that the products TP and TPD, to which this declaration relates, are in conformity with these Council directives on the approximation of the laws of the EC member states:

– Machinery Directive (2006/42/EC).
  Standards used: EN 809: 1998 and EN 60204-1: 2006.
– ATEX Directive (94/9/EC) (applies only to products with the ATEX mark on the nameplate).
  Standards used: EN 13463-1: 2001 and EN 13463-5: 2003.
  (Declaration of conformity and installation and operating instructions of the motor are enclosed.)
  Notified body holding copy of technical file: KEMA Quality B.V., No 0344. Utrechtseweg 310, 6802 ED, Arnhem, The Netherlands.

CN: EC 产品合格声明书

我们格兰富在我们的全权责任下声明，产品 TP 和 TPD，即该合格证所指之产品，符合欧共体使其成员国法律趋于一致的以下欧共理事会指令：

– 机械设备指令 (2006/42/EC)。
  所用标准 : EN 809: 1998 和 EN 60204-1: 2006。
– ATEX 94/9/EC (仅应用于铭牌上有 ATEX 标识的产品)。
  所用标准：EN 13463-1: 2001 和 EN 13463-5: 2003 (电机的符合声明和安装操作说明将作为附件提供)。
  通知机构持有技术文件的副本：荷兰阿纳姆 KEMA 的质量 B.V., No 0344. Utrechtseweg 310, 6802 ED

Bjerringbro, 14th February 2011

Svend Aage Kaae
Technical Director
Grundfos Holding A/S
Poul Due Jensens Vej 7
8850 Bjerringbro, Denmark

Person authorised to compile technical file and empowered to sign the EC declaration of conformity.

Original installation and operating instructions.

CONTENTS



Warning

Prior to installation, read these installation and operating instructions. Installation and operation must comply with local regulations and accepted codes of good practice.

1. Symbols used in this document

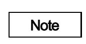


Warning

If these safety instructions are not observed, it may result in personal injury.



If these safety instructions are not observed, it may result in malfunction or damage to the equipment.



Notes or instructions that make the job easier and ensure safe operation.

2. General

These instructions apply to the pump types TP and TPD fitted with Grundfos motors. If the pump is fitted with another motor make, please note that the motor data may differ from the data stated in these instructions.

3. Delivery and handling

3.1 Delivery

The pump is delivered from the factory in a carton with a wooden bottom, which is specially designed for transport by fork-lift truck or a similar vehicle.

3.2 Handling



Warning

The lifting eyes fitted to large pump motors can be used for lifting the pump head (motor, motor stool and impeller). The lifting eyes <u>must not</u> be used for lifting the entire pump.

<u>TPD:</u> The centrally positioned thread of the pump housing <u>must not</u> be used for lifting purposes as the thread is placed below the centre of gravity of the pump.

Pumps without lifting eyes should be lifted by means of nylon straps. See figs 1 and 2.

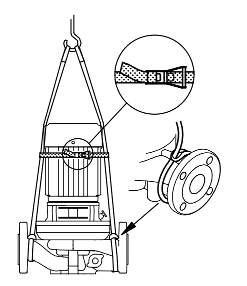


Fig. 1 TP

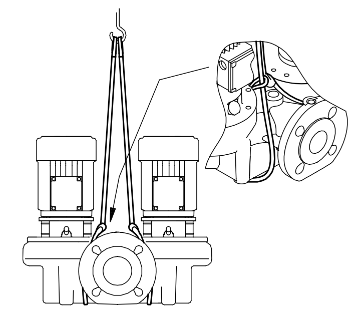


Fig. 2 TPD

Pumps with lifting eyes should be lifted by means of nylon straps and shackles. See figs 3 and 4.

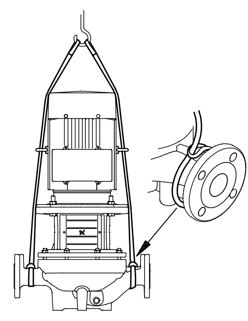


Fig. 3 TP

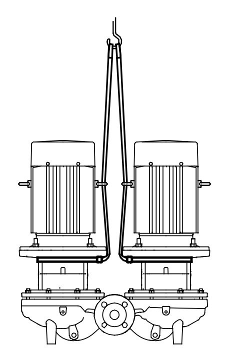


Fig. 4 TPD

4. Applications

The pumps are designed to circulate hot or cold water in for instance

- heating systems
- district heating plants
- central heating systems for blocks of flats
- air-conditioning systems
- cooling systems

in residential, institutional and industrial applications.

In addition, the pump range is used for liquid transfer and water supply in for instance

- washing systems
- domestic hot water systems
- industrial systems in general.

To ensure optimum operation, the dimensioning range of the system must fall within the performance range of the pump.

4.1 Pumped liquids

Thin, clean, non-aggressive and non-explosive liquids, not containing solid particles or fibres that may attack the pump mechanically or chemically.

Examples:

- central heating system water (the water should meet the requirements of accepted standards on water quality in heating systems)
- cooling liquids
- domestic hot water
- industrial liquids
- softened water.

The pumping of liquids with a density and/or kinematic viscosity higher than that of water will cause

- a considerable pressure drop
- a drop in hydraulic performance
- a rise in power consumption.

In such cases, the pump should be fitted with a bigger motor. If in doubt, contact Grundfos.

The EPDM O-rings fitted as standard are primarily suitable for water.

If the water contains mineral/synthetic oils or chemicals or if other liquids than water are pumped, the O-rings should be chosen accordingly.

5. Installation



Warning

When pumping hot or cold liquids, ensure that persons cannot accidentally come into contact with hot or cold surfaces.

The pump must be sited in a dry well ventilated, but frost-free position.

When installing pumps with oval bolt holes in the pump flange (PN 6/10), washers must be used as shown in fig. 5.

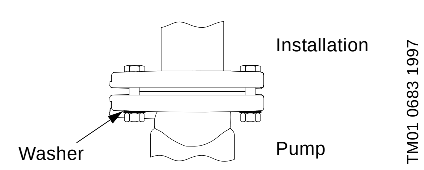


Fig. 5 Use of washers for oval bolt holes

Arrows on the pump housing show the direction of flow of liquid through the pump.

Pumps with motors smaller than 11 kW can be installed in horizontal or vertical pipework.

Pumps with motors of 11 kW and up may only be installed in horizontal pipework with the motor in vertical position.

Caution ***The motor must never fall below the horizontal plane.***

For inspection and motor/pump head removal, the following clearance is required above the motor:

- 300 mm for motors up to and including 4.0 kW.
- 1 metre for motors of 5.5 kW and up.

See fig. 6.

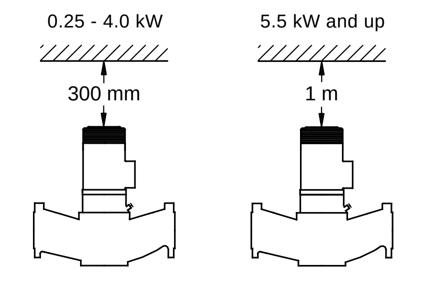


Fig. 6 Required clearance above the motor

Twin-head pumps installed in horizontal pipes must be fitted with an automatic air vent in the upper part of the pump housing. See fig. 7.
The automatic air vent is not supplied with the pump.

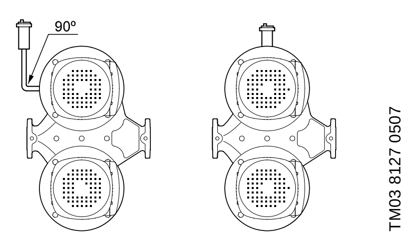


Fig. 7 Automatic air vent

If the liquid temperature falls below the ambient temperature, condensation may form in the motor during inactivity. In this case, it must be ensured that the drain hole in the motor flange is open and points downwards. See fig. 8.

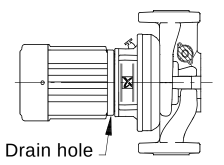


Fig. 8 Drain hole in motor flange

If twin-head pumps are used for pumping liquids with a temperature below 0 °C/32 °F, condensed water may freeze and cause the coupling to get stuck.
The problem can be remedied by installing heating elements. Whenever possible (pumps with motors smaller than 11 kW), the pump should be installed with the motor shaft in horizontal position. See fig. 7.

Caution ***The technical data in section 9. must be observed.***

5.1 Pipework

Isolating valves should be fitted either side of the pump to avoid draining the system if the pump needs to be cleaned or repaired.

The pump is suitable for pipeline mounting, provided that the pipework is adequately supported either side of the pump. TP 25-50, 25-90, 32-50, 32-90, 40-50 and 40-90 are designed for pipeline mounting only.

When installing the pipes, it must be ensured that the pump housing is not stressed by the pipework.

The suction and discharge pipes must be of an adequate size, taking the pump inlet pressure into account.

To avoid sediment build-up, do not fit the pump at the lowest point of the system.

Install the pipes so that air locks are avoided, especially on the suction side of the pump.
See fig. 9.

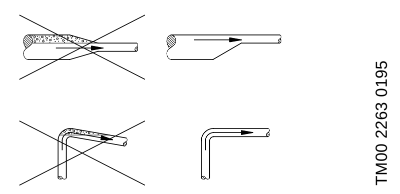


Fig. 9 Correct pipework on the suction side of the pump

Caution

The pump is not allowed to run against a closed discharge valve as this will cause an increase in temperature/formation of steam in the pump which may cause damage to the pump.

If there is any danger of the pump running against a closed discharge valve, a minimum liquid flow through the pump should be ensured by connecting a bypass/a drain to the discharge pipe.
The drain can for instance be connected to a tank.
A minimum flow rate equal to 10 % of the flow rate at maximum efficiency is needed at all times.

Flow rate and head at maximum efficiency are stated on the pump nameplate.

5.2 Elimination of noise and vibrations

In order to achieve optimum operation and minimum noise and vibration, consider vibration dampening of the pump. Generally, always consider this for pumps with motors of 11 kW and up, but for motors of 90 kW and up as well as the pumps stated in the table on page 40, vibration dampening is mandatory.
Smaller motor sizes, however, may also cause undesirable noise and vibration.

Noise and vibration are generated by the revolutions of the motor and pump and by the flow in pipes and fittings. The effect on the environment is subjective and depends on correct installation and the state of the remaining system.

Elimination of noise and vibrations is best achieved by means of a concrete foundation, vibration dampers and expansion joints.

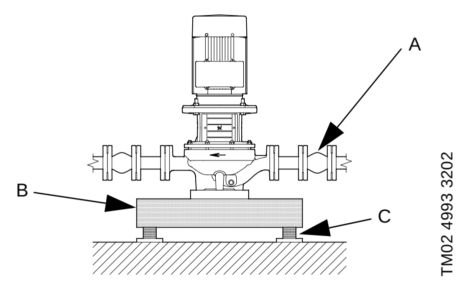


Fig. 10 Foundation for TP pump

A: Expansion joint

B: Concrete pedestal

C: Vibration damper

At high liquid velocities (> 5 m/s), it is recommended to fit larger expansion joints matching the pipework.

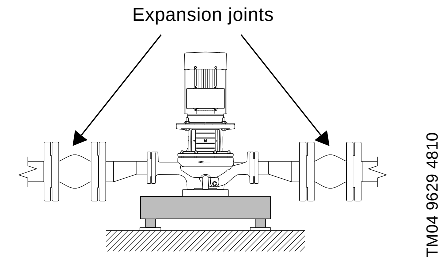


Fig. 11 TP pump installed with larger expansion joints

5.3 Foundation

Grundfos recommends to install the pump on a concrete foundation which is heavy enough to provide permanent and rigid support to the entire pump. The foundation must be capable of absorbing any vibration, normal strain or shock. As a rule of thumb, the weight of the concrete foundation should be 1.5 times the weight of the pump. Place the pump on the foundation and fasten it. See fig. 10.

5.3.1 Recommended concrete foundations for TP(D) Series 300 pumps

For TP Series 300 pumps with weights of 150 kg or more, it is recommended to mount the pump on a concrete foundation with the dimensions stated in the table below. The same recommendation applies for TPD Series 300 pumps with weights of 300 kg or more.

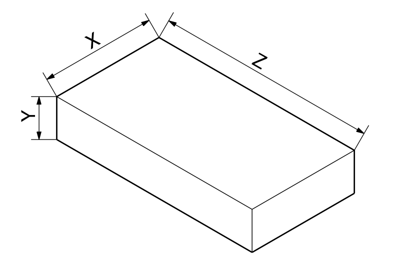


Fig. 12 Foundation for TP(D) Series 300 pumps

Concrete foundation dimensions

Pump weight [kg]	Y (height) [mm]	Z (length) [mm]	X (width) [mm]
150	280	565	565
200	310	620	620
250	330	670	670
300	360	710	710
350	375	750	750
400	390	780	780
450	410	810	810
500	420	840	840
550	440	870	870
600	450	900	900
650	460	920	920
700	470	940	940
750	480	970	970
800	490	990	990
850	500	1010	1010
900	510	1030	1030
950	520	1050	1050
1000	530	1060	1060
1050	540	1080	1080
1100	550	1100	1100
1150	560	1100	1100
1200	560	1130	1130
1250	570	1150	1150
1300	580	1160	1160
1350	590	1180	1180
1400	600	1190	1190
1450	600	1200	1200
1500	610	1220	1220
1550	620	1230	1230
1600	620	1250	1250
1650	630	1250	1250
1700	635	1270	1270

5.4 Terminal box positions

Warning

Before starting work on the pump, make sure that the power supply has been switched off and that it cannot be accidentally switched on.

The terminal box can be turned to any of four positions, in 90 ° steps.

Change the terminal box position as follows:

1. If necessary, remove the coupling guards using a screwdriver. Do not remove the coupling.
2. Remove the screws securing the motor to the pump.
3. Turn the motor to the required position.
4. Replace and tighten the screws.
5. Replace the coupling guards.

5.5 Base plate

Single-head pumps (except TP 25-50, 25-90, 32-50, 32-90, 40-50 and 40-90) have two tapped holes in the bottom of the pump housing which can be used for fitting a Grundfos base plate to the pump.
The base plate is available as an optional extra.

Twin-head pumps have four tapped holes in the bottom of the pump housing. For some twin-head pumps, a base plate consisting of two halves is available.

Base plates with dimensions are shown on page 41.

5.6 Frost protection

Pumps which are not being used during periods of frost should be drained to avoid damage.

6. Electrical connection

The electrical connection should be carried out in accordance with local regulations.



Warning

Before removing the terminal box cover and before any removal/dismantling of the pump, make sure that the power supply has been switched off.

The pump must be connected to an external mains switch with a minimum contact gap of 3 mm in all poles.

The operating voltage and frequency are marked on the pump nameplate. Make sure that the motor is suitable for the power supply on which it will be used.

Single-phase standard motors incorporate a thermal switch and require no additional motor protection.

Three-phase motors must be connected to a motor starter.

Motors of 3 kW and up incorporate thermistors (PTC). The thermistors are designed according to DIN 44082.

The electrical connection should be carried out as shown in the diagram inside the terminal box cover.

The motors of twin-head pumps are to be connected separately.

Caution

Do not start the pump until it has been filled with liquid and vented.

6.1 Frequency converter operation

Caution

Motors types MEZ 63, MG 71 and MG 80 for supply voltages up to and including 440 V (see motor nameplate) must be protected against voltage peaks higher than 650 V between the supply terminals.

Grundfos motors:

All three-phase Grundfos motors from frame size 90 and up can be connected to a frequency converter.

The connection of a frequency converter will often have the effect that the motor insulation system is loaded more and that the motor will be more noisy than during normal operation. In addition, large motors are loaded by bearing currents caused by the frequency converter.

In the case of frequency converter operation, the following should be considered:

- In 2-, 4- and 6-pole motors of 45 kW and up, one of the motor bearings should be electrically isolated to prevent damaging currents from passing through the motor bearings.
- In the case of noise-critical applications, the motor noise can be reduced by fitting a dU/dt filter between the motor and the frequency converter. In particularly noise-critical applications, it is recommended to fit a sinusoidal filter.
- The length of the cable between motor and frequency converter affects the motor load. It should therefore be checked that the cable length meets the specifications laid down by the frequency converter supplier.
- For supply voltages between 500 and 690 V, either a dU/dt filter should be fitted to reduce voltage peaks or a motor with reinforced insulation should be used.
- For supply voltages of 690 V, a motor with reinforced insulation should be used and a dU/dt filter should be fitted.

6.1.1 Other motor makes than Grundfos

Contact Grundfos or the motor manufacturer.

7. Start-up



Do not start the pump until it has been filled with liquid and vented. To ensure correct venting, the vent screw should point upwards.

7.1 Priming

Closed systems or open systems where the liquid level is above the pump inlet:

1. Close the discharge isolating valve and loosen the air vent screw in the motor stool. See fig. 13.



Warning

Pay attention to the direction of the vent hole, and ensure that the escaping liquid does not cause injury to persons or damage to the motor or other components.

In hot-liquid installations, pay special attention to the risk of injury caused by scalding hot liquid.

In cold-liquid installations, pay special attention to the risk of injury caused by the cold liquid.

2. Slowly open the isolating valve in the suction pipe until a steady stream of liquid runs out of the vent hole.
3. Tighten the air vent screw and completely open the isolating valve(s).

Open systems where the liquid level is below the pump inlet:

The suction pipe and the pump must be filled with liquid and vented before the pump is started.

1. Close the discharge isolating valve and open the isolating valve in the suction pipe.
2. Loosen the air vent screw. See fig. 13.
3. Remove the plug from one of the pump flanges, depending on the pump location.
4. Pour liquid through the priming port until the suction pipe and the pump are filled with liquid.
5. Replace the plug and tighten securely.
6. Tighten the air vent screw.

The suction pipe can to some extent be filled with liquid and vented before it is connected to the pump. A priming device can also be installed before the pump.

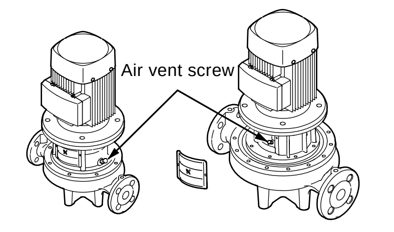
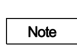


Fig. 13 Position of air vent screw

7.2 Checking the direction of rotation

Do not start the pump to check the direction of rotation until it has been filled with liquid.



The direction of rotation should not be checked with the motor alone, as an adjustment of the shaft position is required when the coupling has been removed.

The correct direction of rotation is shown by arrows on the motor fan cover or on the pump housing.

7.3 Starting

1. Before starting the pump, completely open the isolating valve on the suction side of the pump and leave the discharge isolating valve almost closed.
2. Start the pump.
3. Vent the pump during starting by loosening the air vent screw in the motor stool until a steady stream of liquid runs out of the vent hole. See fig. 13.



Warning

Pay attention to the direction of the vent hole, and ensure that the escaping liquid does not cause injury to persons or damage to the motor or other components.

In hot-liquid installations, pay special attention to the risk of injury caused by scalding hot liquid.

In cold-liquid installations, pay special attention to the risk of injury caused by the cold liquid.

4. When the piping system has been filled with liquid, slowly open the discharge isolating valve until it is completely open.

7.4 Frequency of starts and stops

Frame size	Maximum number of starts per hour		
	Number of poles		
	2	**4**	**6**
56-71	100	250	350
80-100	60	140	160
112-132	30	60	80
160-180	15	30	50
200-225	8	15	30
250-315	4	8	12

- On twin-head pumps, the duty and standby pumps should be alternated on a regular basis, i.e. once a week, to ensure an even distribution of the operating hours on both pumps.
  Pump change can be effected either manually or automatically by installing a suitable pump controller.
- If twin-head pumps are used for pumping domestic hot water, the duty and standby pumps should be alternated on a regular basis, i.e. once a day, to avoid blocking of the standby pump due to deposits (calcareous deposits, etc.).
  Automatic pump change is recommended.

8. Maintenance and service



Warning

Before starting work on the pump, make sure that the power supply has been switched off and that it cannot be accidentally switched on.

Ensure that the escaping liquid does not cause injury to persons or damage to the motor or other components.

In hot-liquid installations, pay special attention to the risk of injury caused by scalding hot liquid.

In cold-liquid installations, pay special attention to the risk of injury caused by the cold liquid.

8.1 Pump

The pump is maintenance-free.

If the pump is to be drained for a long period of inactivity, inject a few drops of silicone oil on the shaft between the motor stool and the coupling. This will prevent the shaft seal faces from sticking.

8.2 Motor

The motor should be checked at regular intervals. It is important to keep the motor clean in order to ensure adequate ventilation. If the pump is installed in a dusty environment, the pump must he cleaned and checked regularly.

Lubrication:

The bearings of motors up to 11 kW are greased for life and require no lubrication.

The bearings of motors of 11 kW and up must be greased in accordance with the indications on the motor nameplate.

The motor should be lubricated with a lithium-based grease meeting the following specifications:

- NLGI grade 2 or 3.
- Viscosity of basic oil: 70 to 150 cSt at 40 °C (~ +104 °F).
- Temperature range: –30 °C (~ –22 °F) to 140 °C (~ +284 °F) during continuous operation.

8.3 Service



Warning

If the pump has been used for a liquid which is injurious to health or toxic, the pump will be classified as contaminated.

If Grundfos is requested to service the pump, Grundfos must be contacted with details about the pumped liquid, etc. before the pump is returned for service. Otherwise Grundfos can refuse to accept the pump for service.

Possible costs of returning the pump are paid by the customer.

8.4 Shaft adjustment

If the motor has been removed during installation or for repair of the pump, the pump shaft must be adjusted after the motor has been replaced.

8.4.1 Pumps with two-part coupling

Pumps Series 100 and 200

Make sure that the shaft pin is fitted in the pump shaft.

Adjust the pump shaft as follows:

1. Remove the coupling guards using a screwdriver.
2. Fit the hexagon socket head screws in the coupling and leave loose.
3. Raise the coupling and the pump shaft as far as possible (towards the motor) with a screwdriver or a similar tool so that the pump and motor shafts touch each other. See fig. 14.

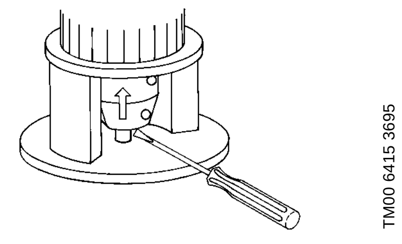


Fig. 14 Raising the coupling and the pump shaft

4. Tighten the hexagon socket head screws in the coupling to 5 Nm (0.5 kpm).
5. Check that the gaps either side of the coupling halves are equal.
6. Tighten the screws two and two (one side at a time) to the torque stated below. See fig. 15.

Hexagon socket head screw	Torque
M6 x 20	13 Nm (1.3 kpm)
M8 x 25	31 Nm (3.1 kpm)

7. Fit the coupling guards.

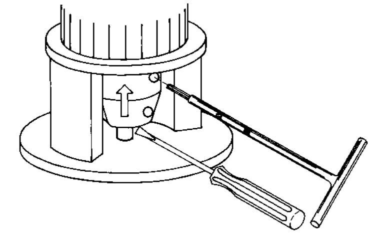


Fig. 15 Tightening the screws

8.4.2 Pumps with integral shaft/coupling

For pumps with integral shaft/coupling, it is advisable *not* to remove the motor. If the motor has been removed, it is necessary to remove the motor stool in order to refit the motor correctly. Otherwise the shaft seal may be damaged.

8.5 Blanking flanges

For twin-head pumps, a blanking flange with a pump housing gasket is available. See fig. 16.

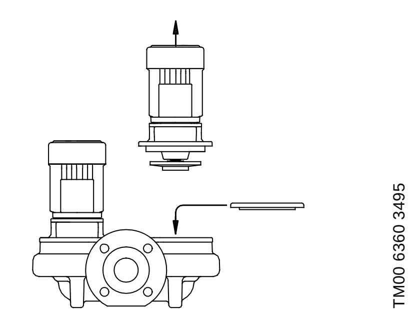


Fig. 16 Fitting the blanking flange

If one pump requires service, the blanking flange is fitted to allow the other pump to continue operating.

9. Technical data

9.1 Ambient temperature

Maximum +55 °C (~ +131 °F).

9.2 Liquid temperature

–25 °C (~ –13 °F) up to +140 °C (~ +288 °F).

The maximum liquid temperature depends on the mechanical shaft seal type and the pump type.

Depending on the cast-iron version and the pump application, the maximum liquid temperature may be limited by local regulations and laws.

The maximum liquid temperature is marked on the pump nameplate.

Note ***If the pump is operating with liquids at high temperatures, the life of the shaft seal may be reduced. It may be necessary to replace the shaft seal more often.***

9.3 Operating pressure/test pressure

The pressure test has been made with water containing anti-corrosive additives at a temperature of +20 °C (~ +68 °F).

Pressure stage	Operating pressure		Test pressure	
	bar	MPa	bar	MPa
PN 6	6	0.6	10	1.0
PN 6/PN 10	10	1.0	15	1.5
PN 16	16	1.6	24	2.4

9.4 Inlet pressure

To ensure optimum and quiet pump operation, the inlet pressure (system pressure) must be adjusted correctly. See table on page 27.

For the calculation of specific inlet pressures, contact the local Grundfos company or see the data booklet for TP(D)/TPE(D), if at hand.

9.5 Enclosure class

Closed drain hole in motor: IP55.
Open drain hole in motor: IP44.
(Drain hole, see fig. 8.)

9.6 Electrical data

See motor nameplate.

9.7 Sound pressure level

Pumps with single-phase motors:

The sound pressure level of the pump is lower than 70 dB(A).

Pumps with three-phase motors:

See table on page 39.

9.8 Environment

Non-aggressive and non-explosive atmosphere.

Relative air humidity: Maximum 95 %.

10. Fault finding chart



Warning

Before removing the terminal box cover and before removal/dismantling of the pump, make sure that the power supply has been switched off and that it cannot be accidentally switched on.

Ensure that the escaping liquid does not cause injury to persons or damage to the motor or other components.

In hot-liquid installations, pay special attention to the risk of injury caused by scalding hot liquid.

In cold-liquid installations, pay special attention to the risk of injury caused by the cold liquid.

Fault	Cause
1. Motor does not run when started.	a) Supply failure. b) Fuses blown. c) Motor starter overload has tripped out. d) Main contacts in motor starter are not making contact or the coil is faulty. e) Control circuit fuses are defective. f) Motor is defective.
2. Motor starter overload trips out immediately when supply is switched on.	a) Supply failure. b) Contacts in motor starter overload are faulty. c) Cable connection is loose or faulty. d) Motor winding is defective. e) Pump mechanically blocked. f) Overload setting too low.
3. Motor starter overload trips out occasionally.	a) Overload setting too low. b) Supply voltage periodically too low or too high. c) Differential pressure across pump too low.
4. Motor starter has not tripped out but the pump does not run.	a) Check the power supply. b) Check fuses. c) Check main contacts in motor starter and coil. d) Check the control circuit.
5. Pump capacity not constant.	a) Pump inlet pressure is too low. b) Suction pipe/pump partly blocked by impurities. c) Pump draws in air.
6. Pump runs but gives no water.	a) Suction pipe/pump blocked by impurities. b) Foot or non-return valve blocked in closed position. c) Leakage in suction pipe. d) Air in suction pipe or pump. e) Motor rotates in the wrong direction.
7. Pump runs backwards when switched off.*	a) Leakage in suction pipe. b) Foot or non-return valve defective. c) Foot or non-return valve blocked in open or partly open position.
8. Leakage in shaft seal.	a) Pump shaft position is incorrect. b) Shaft seal is defective.

Fault	Cause
9. Noise.	a) Pump is cavitating. b) Pump does not rotate freely (frictional resistance) because of incorrect pump shaft position. c) Frequency converter operation: See *6.1 Frequency converter operation*. d) Resonance in the installation. e) Foreign bodies in the pump.
10. Pump runs constantly (applies only to pumps with automatic start/stop).	a) Stop pressure is too high in relation to the required quantity of water. b) The water consumption is larger than anticipated. c) Leakage in discharge pipe. d) The direction of rotation of the pump is incorrect. e) Pipes, valves or strainer blocked by impurities. f) Pump controller, if used, is defective.
11. Period of operation is too long (applies only to pumps with automatic start/stop).	a) Stop pressure is too high in relation to the required quantity of water. b) Pipes, valves or strainer blocked by impurities. c) Pump partly blocked or furred up. d) The water consumption is larger than anticipated. e) Leakage in discharge pipe.

* In twin-head pump installations, the standby pump will often rotate slowly.

11. Disposal

This product or parts of it must be disposed of in an environmentally sound way:

1. Use the public or private waste collection service.
2. If this is not possible, contact the nearest Grundfos company or service workshop.

Subject to alterations.

中文 (CN) 安装和使用说明书

目录

警告

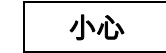
装机前，先仔细阅读本安装操作手册。安装和运行必须遵守当地规章制度并符合公认的良好操作习惯。

1. 本文献中所用符号

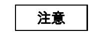


警告

不执行这些安全须知可能会引起人身伤害。



不执行这些安全须知可能会导致故障发生或设备损坏。



可以使工作简化和保证安全的注意事项或须知。

2. 概述

本手册适用于配备有格兰富电机的TP和TPD型水泵。如果水泵安装了其它类型的电机，务必要注意其电机资料可能会与本说明手册不同。

3. 交付和吊装

3.1 交付

该水泵出厂包装箱经过独特的设计，木料的承重底部，方便了使用叉车或类似工具进行搬运。

3.2 吊装

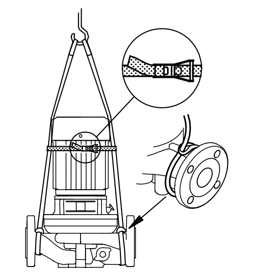


警告

大型水泵电机配备的吊眼可用于起吊泵头（电机、电机托架和叶轮）。吊眼不得用于起吊整个水泵。

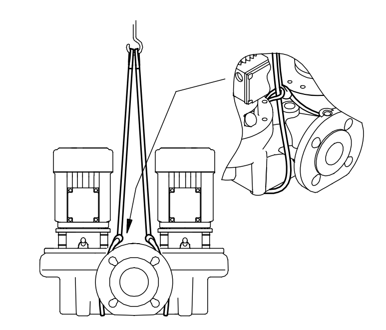
TPD: 水泵外壳中央的线索不能用来起吊，这是因为线索位于水泵的重心之下。

不带吊眼的水泵应该用尼龙带起吊。参见图 1 和 2。



TM02 7007 2303

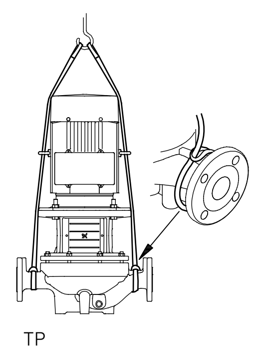
图 1　　TP



TM02 7008 2303

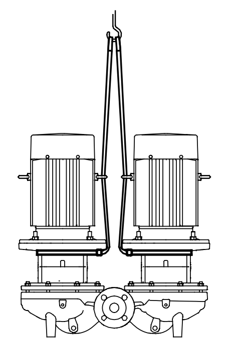
图 2　　TPD

有吊眼的水泵应使用尼龙带和缩紧卡环起吊。参见图 3 和 4。



TM02 7009 2303

图 3　　TP



TM02 7010 2303

图 4　　TPD

4. 应用

本系列水泵设计应用于冷热水循环系统

- 供热系统
- 区域供暖站
- 公寓楼的集中供暖系统
- 空调系统
- 冷却系统

常见于居民区、公共机构和工业应用中。

此外，本系列水泵还适用于液体输送和给水系统

- 清洗系统
- 生活热水系统
- 一般的工业系统

为了达到最佳工作状态，系统的工作范围必须处于水泵的性能范围之内。

4.1 泵送液体

泵送的液体应该具有易流动、粘度小、清洁、无腐蚀性、无爆炸性，不得含有对水泵造成机械或者化学损伤的固体颗粒物质或者纤维。

举例说明：

- 集中供热系统 （泵送水质应符合公认的供热系统水质标准要求）
- 冷却液
- 家用热水
- 工业用液体
- 软化水

如果泵送液体的密度ρ和/或运动粘度ν高于水的密度ρ和运动粘度ν，将会导致：

- 压力大幅度下降
- 水力性能降低
- 能源消耗增加

这种情况下，水泵应该配置更大的电机。如有疑问，请联系格兰富公司。

作为标准安装的EPDM O型圈主要适用于水。

如果水中含有矿物质、合成油或者化学物质，或者泵送的液体是水以外的其它液体，应相应地选择O型圈。

5. 安装



警告

当泵的工作液体为高温或低温时，请注意避免人员意外接触到高温或低温表面。

水泵必须放置于干燥、通风且无霜冻的场所。

用水泵法兰 （PN 6/10）中的椭圆螺栓孔安装水泵时，要使用垫圈，如图 5。

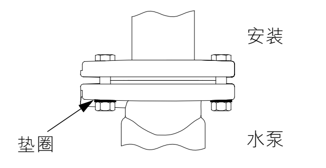


图 5　　在椭圆螺栓孔上使用垫圈

泵壳体上的箭头表示液体通过泵的流通方向。

电机功率最大在11 千瓦以下的水泵可以安装在水平或者垂直的管道系统中。

电机功率等于或者大于11 千瓦的水泵只能安装在水平的管道系统中，而且电机应该垂直放置。

小心　*电机不得低于水平面。*

为了检测和拆卸电机/水泵头，电机风扇端预留空间的长度度规定如下：

- 功率为 4.0 千瓦及以下的电机为 300 mm。
- 功率为 5.5 千瓦及以上的电机为1 米。

参见图 6。

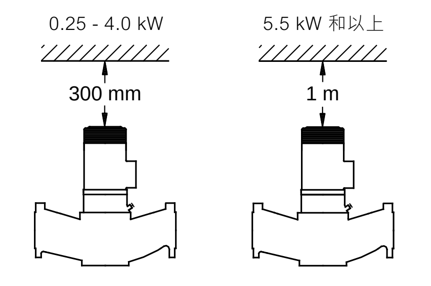
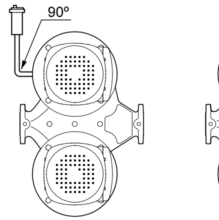


图 6　　电机上方的的空隙

安装在水平管里的双头水泵必须在水泵外壳的上部分安装一个自动排气阀。参见图 7。
自动排气阀不随泵一起供应。



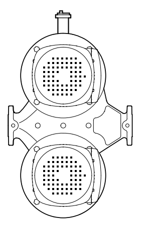


图 7　　自动排气阀

如果液体的温度降低到环境温度以下，水泵停机后在电机里可能出现凝水现象。在这种情况下须确保打开电机法兰的排水孔，使其朝下。参见图 8。

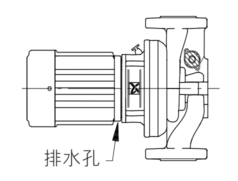


图 8　　电机法兰的排水孔

若使用双头水泵泵送温度低于0 °C/32 °F的液体，冷凝水可能会结冰并导致联轴器无法运转。安装加热元件可防止冻结问题。如有可能 （电机功率低于11 千瓦的水泵），水泵安装时，电机轴应处于水平位置。
参见图 7。

小心　*务必遵循 9. 节技术数据的说明要求。*

5.1 管路连接

水泵的两侧应该安装隔离阀，以避免清洁或维修水泵时系统被排空。

如果水泵两侧的管道系统能被充分支撑起来，水泵可以进行管线安装。TP 25-50, 25-90, 32-50, 32-90, 40-50 和40-90专门用于管线安装。

安装管路时，务必确保泵壳不会受到管道的牵拉。

吸水管和排水管的尺寸必须恰当，同时需要考虑到泵的入口压力。

不得将水泵安装在系统的最低点以避免产生污物沉积。

安装管道时应注意避免气穴形成，特别是在泵的吸入侧。参见图 9.

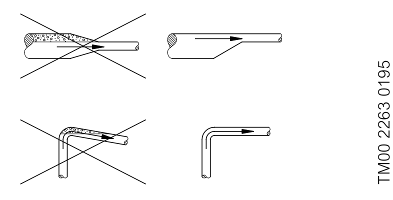


图 9　　在水泵的吸水侧安装正确的管道。

小心　*不要在出口阀关闭时运转水泵，因为这可能导致温度升高/泵内液体汽化，从而损坏水泵。*

如果水泵存在任何在出口阀关闭情况下运行的可能，应该在出口阀前的排出管路上连接一个旁通 / 排水管以确保最小流量得以流经水泵。比如，排水管可以与一个水箱连接。始终确保水泵的最低流量为其最高效率工作时流量的10 %。

最大效率工作时流速和扬程请详见水泵铭牌。

5.2 降噪和减振

为了达到最佳工作状态，将噪音和振动降至最低，可考虑为水泵安装减振器。一般来说，对于电机功率不小于11 千瓦的水泵需要考虑安装减振器，而对于功率在90 千瓦及以上的水泵以及 40 页的表格中列出的水泵则必须安装减振器。较小功率的电机也会发生较大的噪音和振动。

噪音和振动是由于电机和水泵运转，以及水管和管道配件中的水流造成的。对环境造成的影响取决于安装是否正确以及其余系统的工作状态。

降噪减振最好的方法是使用混凝土基础、减振器和伸缩接头。

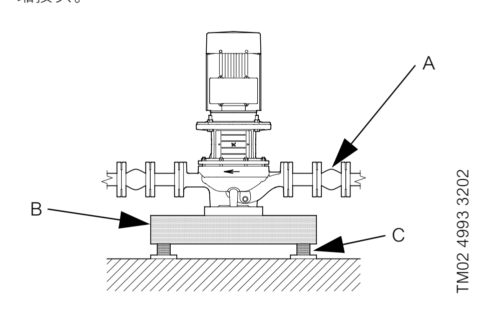


图 10　　TP水泵基座

A: 伸缩接头

B: 混凝土基座

C: 减振器

在水流速度高的场合 （大于5 米/秒），建议安装与管道系统相配的较大的伸缩接头。

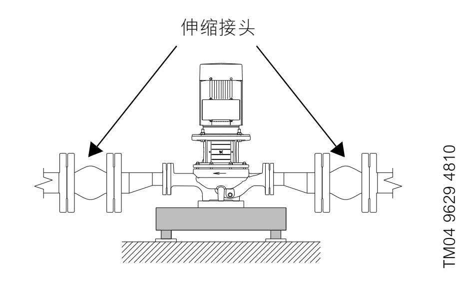


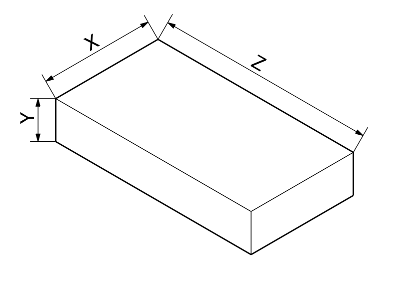
图 11　　安装较大的伸缩接头的TP水泵

5.3 基础

格兰富建议将泵安装在混凝土基础上，这种基础足够结实，可以为整个泵提供永久而坚固的支撑。基础必须能够吸收振动，正常的应力或冲击。根据经验，混凝土基础的重量应该为泵总重的1.5倍。将泵放置在基础上，将其固定。参见图 10。

5.3.1 建议对TP(D)300系列的水泵使用混凝土基础。

对于TP300系列的水泵中重量等于或大于150 公斤的水泵，建议按照下表所示的规格标准安装在混凝土基础上。以上建议同样适用于TP300系列的水泵中重量不小于300 公斤的水泵。



TM03 9190 3607

图 12　TP(D)300系列的水泵基座

混凝土基础尺寸规格

水泵重量 [kg]	Y（高度）[mm]	Z（长度）[mm]	X（宽度）[mm]
150	280	565	565
200	310	620	620
250	330	670	670
300	360	710	710
350	375	750	750
400	390	780	780
450	410	810	810
500	420	840	840
550	440	870	870
600	450	900	900
650	460	920	920
700	470	940	940
750	480	970	970
800	490	990	990
850	500	1010	1010
900	510	1030	1030
950	520	1050	1050
1000	530	1060	1060
1050	540	1080	1080
1100	550	1100	1100
1150	560	1100	1100

混凝土基础尺寸规格

水泵重量 [kg]	Y（高度）[mm]	Z（长度）[mm]	X（宽度）[mm]
1200	560	1130	1130
1250	570	1150	1150
1300	580	1160	1160
1350	590	1180	1180
1400	600	1190	1190
1450	600	1200	1200
1500	610	1220	1220
1550	620	1230	1230
1600	620	1250	1250
1650	630	1250	1250
1700	635	1270	1270

5.4 接线盒位置



警告

在水泵启动工作前，应确保电源断开，并且不会被意外接通。

端子盒可以转到四个位置的任何一个位置，四个位置以 90°分布。

按照下列操作步骤改变端子盒的位置:

1. 必要时，用螺丝起子拆除联轴器护板。不得拆除联轴器。
2. 拆下用来将电机固定在水泵上的螺丝。
3. 将电机转到需要的位置。
4. 重新安装并旋紧螺丝。
5. 重新安装联轴器护板。

5.5 底座

单头水泵 （除TP 25-50, 25-90, 32-50, 32-90, 40-50, 40-90 外）在水泵外壳的底部有两个螺丝孔，可以用来将格兰富底座安装到水泵上。底座为选用附件。

双头水泵在水泵外壳的底部有四个螺丝孔。对一些双头水泵，可以用两个半底座。

底座的尺寸见页 41.

5.6 霜冻防护

如果在霜冻季节不需要使用水泵，应该排空水泵以防损坏。

6. 电气连接

电气连接必须遵照当地法规规章的相关规定。



警告

拆卸端子盒盖子和拆解水泵前，确保电源已断开。

与水泵电动机相连接外部电源开关，其电极间的接触间隙最小为 3 mm。

水泵的铭牌上标有适用的操作电压和频率。确保电动机适用于其供应电源。

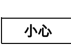
单相标准电机配有一只热控开关，因此不需要另外的电机保护。

三相电动机必须与电机起动器连接使用。

功率为 3 千瓦及以上的电机配有热敏电阻 （PTC）。热敏电阻根据 DIN 44082 设计而成。

电气连接必须按照端子盒盖内的图示进行。

双头水泵的电机应单独连接。



小心	***在加满液体和排气之前不要启动水泵。***

6.1 变频器操作

小心	***电源供应电压为440 伏及440 伏以下的 MEZ 63, MG 71和MG 80型号的电机 （见电机铭牌）必须加以保护以避免出现两电源端子之间的电压的峰值高于650 伏的情况。***

格兰富电动机:

所有机架尺寸大于90 的三相电机都可以与一个变频器相连。

水泵连接变频器工作时会增加电动机绝缘的负载以及电动机运行噪音。此外，大功率电机还会因为轴电流而增加负载。

在连接变频器工作时，以下几点须注意:

- 功率45 千瓦及以上的 2、4、6 极电机，其中的一个轴承应做好电气绝缘，以避免因轴电流而造成的损坏。
- 如果电机噪音很大，可以在电机与变频器之间串联一个dU/dt滤波器来减小噪音。如果电机噪音特别大，我们建议安装正弦滤波器。
- 电机与变频器之间的电缆长度会影响电机负载。因此，应确认电缆长度符合变频器供应商制定的规格要求。
- 如果供电电压在500 伏与690 伏之间，要在电机与变频器之间装dU/dt 滤波器以降低电压峰值，或者强化电机绝缘。
- 如果供电电压在 690 伏及以上，要在电机与变频器之间装 dU/dt 滤波器，并强化电机绝缘。

6.1.1 格兰富以外的其它电动机

联系格兰富公司或电动机制造商。

7. 启动

小心	***在加满液体和排气之前不要启动水泵。排气螺丝应向上，以保证正确的排气。***

7.1 启动前注水

液面水平高于水泵进口的闭式系统或者开式系统:

1. 关闭排放截止阀，并拧松电机托架内的排气螺丝。参见图 13。



警告

注意排气口的方向，务必确保流出的水不会对人员造成损伤或者对电机或其它元件造成损坏。

处理高温液体时，要特别注意防止灼热的液体造成人身伤害等风险。

处理低温液体时，要特别注意防止低温液体造成人身伤害等风险。

2. 慢慢打开进水管里的截止阀，直到稳定的水流通出排气口为止。
3. 旋紧排气螺丝，完全打开截止阀。

液面水平面在水泵进口以下的开式系统:

水泵启动前，进水管和水泵必须充满液体并充分排气。

1. 关闭出口阀，打开进水管里的截止阀。
2. 拧松排气螺丝。参见图 13。
3. 拔出水泵任一法兰的塞子，根据水泵的位置来确定。
4. 通过注水孔注入液体直到吸水管和水泵均充满液体。
5. 重新插上塞子并旋紧。
6. 旋紧排气螺丝。

进水管在连接到水泵之前可以一定程度地充满液体并排气。在水泵前可以安装一个注水器。

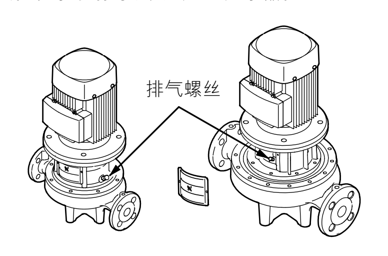
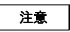


图 13　　排气螺丝位置

中文 (CN)

7.2 检查旋转的方向

在水泵充满液体之前，不得启动水泵检查水泵旋转的方向。



不应只通过电机检查旋转方向，因为取出联轴器之后，轴的位置需要进行调整。

正确的旋转方向必须与电机风扇盖或者水泵外壳上的箭头方向一致。

7.3 启动

1. 启动水泵前，进水侧的截止阀门完全打开，而出水口截止阀门几乎完全关闭。
2. 启动水泵。
3. 启动时，拧松电机托架内的排气螺丝使水泵排气，直到通气孔的液体流量稳定。参见图 13。



警告

注意排气口的方向，务必确保流出的水不会对人员造成损伤或者对电机或其它元件造成损坏。

在高温液体安装中，要特别注意由灼热的液体引起的人身伤害风险。

在高温液体安装中，要特别注意防止灼热的液体造成人身伤害等风险。

在低温液体安装中，要特别注意防止低温液体造成人身伤害等风险。

4. 当管道系统充满液体之后，慢慢打开出水口截止阀门直到其完全打开。

7.4 启动和停机频率

机架尺寸	每小时最大启动次数		
	极 数		
	2	**4**	**6**
56-71	100	250	350
80-100	60	140	160
112-132	30	60	80
160-180	15	30	50
200-225	8	15	30
250-315	4	8	12

- 在双头水泵上，正在运行的水泵和处于待机状态的水泵应该定期轮流运行，如一周轮换一次，以保证两个水泵的运行时间均等。
  交换使用水泵可以采用手工控制来完成，也可以通过安装一个适当的水泵控制器自动完成。
- 若双头水泵用于泵送生活用热水，正在运行的水泵和处于待机状态的水泵应该定期轮流运行，如一天交换一次，以避免待机水泵因为沉积物（如钙质沉积物等）积累而堵塞。
  建议采用自动水泵切换。

8. 保养和维修



警告

在水泵启动工作前，应确保电源断开，且不会被意外接通。

确保溢出的水不会对人员造成伤害或损坏电机或其它部件。

在高温液体安装中，要特别注意防止灼热的液体造成人身伤害等风险。

在低温液体安装中，要特别注意防止低温液体造成人身伤害等风险。

8.1 水泵

水泵是免维护的。

如果水泵因为长时间未用而排空，在电机支架和联轴器之间的轴上注入几滴硅油。
这将有效地防止了轴端密封的粘结。

8.2 电机

每隔一定时间，应对电机进行检查。
保持电机清洁非常重要，以保证充分的通风。如果泵安装在灰尘大的环境中，泵必须定期清洗和检查。

润滑油:

功率为11 千瓦以下的电机轴承上添加的润滑脂可以满足电机整个使用寿命内的需求，因此不需要润滑油。

功率为11 千瓦及以上的电机的轴承必须根据电机铭牌上的说明加润滑脂。

电机应采用锂基润滑脂进行润滑，润滑脂需满足下列规格:

- NLGI 级别 2 或 3。
- 基油粘度: 40 °C (~ +104 °F)温度下为70 至 150 cSt。
- 温度范围: 持续工作时温度为-30 °C (~ -22 °F) 至 140 °C (~ +284 °F)。

8.3 维修保养



警告

如果泵用于有害于健康的液体或有毒的液体，则泵必须按污染分类。

如果要求格兰富对该水泵进行维修，在水泵被送来维修之前 ，必须告知格兰富公司有关泵送液体的详细资料。否则的话，格兰富有权拒绝对该泵进行维修。

泵返厂可能发生的费用由客户承担。

8.4 轴调节

如果在安装过程中或者水泵维修时电机被拆卸，重新安装电机后必须调节水泵轴。

8.4.1 两半式联轴器水泵

100, 200 系列水泵

确保轴销与水泵的轴相吻合。

按下列步骤调节水泵轴:

1. 用螺丝起子拆下联轴器护板。
2. 将内六角头螺丝安装在联轴器里，使螺丝保持松弛状态。
3. 用螺丝起子或者类似工具尽可能地抬起联轴器和水泵轴 （朝电机方向），使水泵轴和电机轴互相接触。参见图 14。

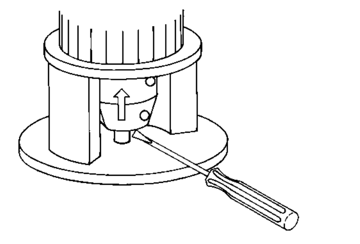


图 14　　抬起联轴器和水泵轴

4. 以5 Nm (0.5 kpm)的转矩将内六角头螺丝安装在联轴器里。
5. 检查并确定两个联轴器部分的每一边的间隙相等。
6. 两个两个地旋紧螺丝 （每次一边），转矩如下表:参见图 15。

内六角头螺丝	转矩
M6 x 20	13 Nm (1.3 kpm)
M8 x 25	31 Nm (3.1 kpm)

7. 安装联轴器护板。

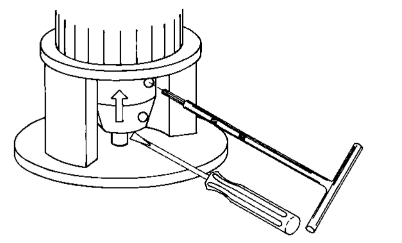


图 15　　旋紧螺丝

8.4.2 配有整体轴 / 联轴器的水泵

针对配有整体轴和联轴器的水泵，我们建议 *不要* 移出电机。如果电机已经被移出，也必须同时移出电机支架，以便重新正确安装电机。否则轴封将被损坏。

8.5 盲板法兰

对于双头水泵，我们可以提供一个带水泵外壳垫圈的盲板法兰。参见图 16。

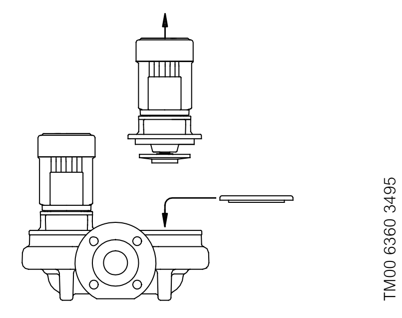


图 16　　安装盲板法兰

如果一个水泵需要进行维修，那么可以安装盲板法兰使另一台水泵继续工作。

9. 技术数据

9.1 环境温度

最高温度 +55 °C (~ +131 °F)。

9.2 液体温度

-25 °C (~ -13 °F) 至 +140 °C (~ +288 °F)。

最高液体温度取决机械轴封的类型和水泵类型。

根据铸铁的类型和水泵用途，液体最大温度还可能受地方法律法规的限制。

最高液体温度在水泵铭牌上已标明。

注意　***如果水泵用来泵送高温液体，轴封的寿命可能缩短。因此有必要经常更换轴封。***

9.3 操作压力和试验压力

压力试验通过含防腐蚀添加剂的水在＋20 °C （大约为＋68 °F）温度下完成。

压力等级	运行压力		试验压力	
	bar	MPa	bar	MPa
PN 6	6	0.6	10	1.0
PN 6/PN 10	10	1.0	15	1.5
PN 16	16	1.6	24	2.4

9.4 进口压力

为了保证水泵处于最佳工作状态，同时噪音降低到最小的水平，进口压力 （系统压力）必须正确调节。
见 27 页上的表格。

为了计算具体的进口压力，请与当地的格兰富公司联系或者参见TP(D)/TPE(D) 数据手册。

9.5 防护等级

电机闭式排水孔：IP55.
电机开式排水孔：IP44.
（排水孔，参见图 8。）

9.6 电气数据

参见电机铭牌。

9.7 声压水平

单相电机水泵：

水泵的声压水平低于70 dB(A)。

三相电机水泵：

参见 39页上的表格。

9.8 环境

无腐蚀性、无爆炸性空气。

相对空气湿度：最大为95 %。

10. 故障查找一览表



警告

拆卸接线盒盖子和拆解水泵前，确保电源已断开，且不会意外接通。
确保溢出的水不会对人员造成伤害或损坏电机或其它部件。
在高温液体安装中，要特别注意防止灼热的液体造成人身伤害等风险。
在低温液体安装中，要特别注意由低温液体引起的人身伤害风险。

故障	原因
1. 电机启动时不能运行。	a) 断电。 b) 保险丝熔断。 c) 电机起动器过载跳闸。 d) 电机起动器的主触点未接触或线圈有故障。 e) 控制电路保险丝损坏。 f) 电机损坏。
2. 电源打开后电机起动器过载立即断开。	a) 电源故障 b) 电机起动器过载的触点有故障。 c) 电缆连接松开或者出现故障。 d) 电机绕组损坏。 e) 水泵发生机械性堵塞。 f) 过载设置太低。
3. 电机起动器过载偶尔跳闸。	a) 过载设置太低。 b) 供给电压周期性过低或者过高。 c) 通过水泵的压差太低。
4. 电机起动器未跳闸但泵没有运行。	a) 接通电源。 b) 检查保险丝。 c) 检查电机起动器和线圈的触点。 d) 检查控制电路。
5. 水泵的出水量不稳定。	a) 水泵进口压力太低。 b) 吸水管和水泵被杂物部分堵塞。 c) 水泵吸入空气。
6. 水泵运行但是不出水。	a) 吸水管/水泵被杂物部分地堵塞。 b) 底阀或者止回阀卡在关闭位置。 c) 吸水管渗漏。 d) 吸入管或泵进了空气。 e) 电机的转动方向错误。
7. 水泵断开时向后运行。*	a) 吸水管渗漏。 b) 底阀或者止回阀门损坏。 c) 底阀或者止回阀门卡在全开或者半开的位置。
8. 轴封泄漏。	a) 水泵轴的位置不正确。 b) 轴封损坏。
9. 噪音。	a) 水泵出现汽穴 （汽蚀）现象。 b) 水泵不能自由转动 （摩擦阻力) 因为水泵轴的位置错误。 c) 变频器操作: 见 *6.1 变频器操作*。 d) 装置出现共振。 e) 泵中有异物。

故障	原因
10. 水泵持续运行（仅适用于具有自动启动和停机功能的水泵）。	a) 相对于所需水量，停机压力太高。 b) 水消耗比预期的要大。 c) 出水管渗漏。 d) 水泵的转动方向错误。 e) 管道、阀门或者过滤器被杂物堵塞。 f) 水泵控制器（如果采用）损坏。
11. 运行周期过长（仅适用于具有自动启动和停机功能的水泵）。	a) 相对于所需水量，停机压力太高。 b) 管道、阀门或者过滤器被杂物堵塞。 c) 水泵部分被杂物堵塞或生垢。 d) 水消耗比预期的要大。 e) 出水管渗漏。

*在双头水泵装置中，处于待机状态的水泵经常慢速转动。

11. 回收处理

必须以环境友好的方式对本产品或产品的部件进行回收处理。

1. 使用公立或私立废品回收服务设施。
2. 如果以上无法做到，与附近的格兰富公司或服务站联系。

内容可有变动。

GB: Inlet pressure stated in bar relative pressure (pressure gauge value measured on the suction side of the pump)

CN: 入口压力为以巴为单位的相对压力 （压力计在水泵进水侧测量到的数值）

50 Hz, 2-pole

Pump type	p [bar]					
50 Hz, 2-pole	**20 °C**	**60 °C**	**90 °C**	**110 °C**	**120 °C**	**140 °C**
TP 25-50R/2	0.1	0.1	0.1	0.8	1.4	3.1
TP 25-90R/2	0.1	0.1	0.1	0.8	1.4	3.1
TP 32-50R/2	0.1	0.1	0.1	0.8	1.4	3.1
TP 32-90R/2	0.1	0.1	0.1	0.8	1.4	3.1
TP(D) 32-60/2	0.1	0.1	0.2	1.0	1.5	3.2
TP(D) 32-120/2	0.1	0.2	0.7	1.5	2.0	3.7
TP(D) 32-150/2	0.1	0.3	0.8	1.6	2.1	3.8
TP(D) 32-180/2	0.5	0.7	1.2	2.0	2.5	4.2
TP(D) 32-230/2	0.7	0.9	1.4	2.2	2.7	4.4
TP(D) 32-200/2	0.1	0.1	0.2	0.9	1.5	3.1
TP(D) 32-250/2	0.1	0.1	0.3	1.0	1.6	3.2
TP(D) 32-320/2	0.1	0.1	0.6	1.3	1.9	3.5
TP(D) 32-380/2	0.1	0.2	0.7	1.4	2.0	3.6
TP(D) 32-460/2	0.1	0.2	0.7	1.4	1.9	3.6
TP(D) 32-580/2	0.2	0.4	0.9	1.6	2.2	3.8
TP 40-50/2	0.1	0.1	0.1	0.8	1.4	3.1
TP 40-90/2	0.1	0.1	0.1	0.8	1.4	3.1
TP(D) 40-60/2	0.1	0.1	0.5	1.2	1.8	3.5
TP(D) 40-120/2	0.1	0.1	0.4	1.2	1.7	3.4
TP(D) 40-180/2	0.1	0.2	0.7	1.5	2.0	3.7
TP(D) 40-190/2	0.1	0.3	0.8	1.6	2.1	3.8
TP(D) 40-230/2	0.7	0.9	1.4	2.2	2.7	4.4
TP(D) 40-270/2	0.7	0.9	1.4	2.2	2.7	4.4
TP(D) 40-240/2	0.1	0.1	0.4	1.1	1.7	3.3
TP(D) 40-300/2	0.1	0.1	0.4	1.1	1.6	3.3
TP(D) 40-360/2	0.2	0.4	0.9	1.6	2.1	3.8
TP(D) 40-470/2	0.1	0.1	0.4	1.1	1.6	3.3
TP(D) 40-580/2	0.2	0.4	0.9	1.6	2.1	3.8
TP(D) 50-60/2	0.1	0.1	0.4	1.1	1.7	3.4
TP(D) 50-120/2	0.1	0.2	0.7	1.5	2.0	3.7
TP(D) 50-180/2	0.1	0.2	0.7	1.4	2.0	3.7
TP(D) 50-160/2	0.1	0.1	0.1	0.8	1.4	3.0

Pump type	p [bar]					
50 Hz, 2-pole	**20 °C**	**60 °C**	**90 °C**	**110 °C**	**120 °C**	**140 °C**
TP(D) 50-190/2	0.1	0.1	0.1	0.8	1.4	3.0
TP(D) 50-240/2	0.1	0.1	0.1	0.8	1.4	3.0
TP(D) 50-290/2	0.1	0.1	0.2	0.9	1.5	3.1
TP(D) 50-360/2	0.1	0.1	0.2	1.0	1.5	3.1
TP(D) 50-430/2	0.1	0.1	0.4	1.1	1.6	3.3
TP(D) 50-440/2	0.1	0.1	0.4	1.1	1.6	3.3
TP(D) 50-570/2	0.1	0.3	0.8	1.6	2.1	3.7
TP(D) 50-710/2	0.6	0.8	1.3	2.0	2.6	4.2
TP(D) 50-830/2	0.5	0.7	1.2	2.0	2.5	4.1
TP(D) 50-960/2	1.0	1.2	1.7	2.4	3.0	4.6
TP(D) 65-60/2	0.1	0.3	0.8	1.5	2.1	3.8
TP(D) 65-120/2	0.5	0.7	1.2	2.0	2.5	4.2
TP(D) 65-180/2	0.3	0.5	1.0	1.8	2.3	4.0
TP(D) 65-190/2	0.1	0.1	0.1	0.7	1.3	2.9
TP(D) 65-230/2	0.1	0.1	0.1	0.8	1.4	3.0
TP(D) 65-260/2	0.1	0.1	0.1	0.8	1.4	3.0
TP(D) 65-340/2	0.1	0.1	0.2	0.9	1.4	3.1
TP(D) 65-410/2	0.1	0.1	0.2	0.9	1.4	3.1
TP(D) 65-460/2	0.1	0.1	0.2	1.0	1.5	3.1
TP(D) 65-550/2	0.1	0.1	0.3	1.0	1.6	3.2
TP(D) 65-660/2	0.1	0.1	0.4	1.1	1.6	3.3
TP(D) 65-720/2	0.1	0.1	0.6	1.3	1.9	3.5
TP(D) 65-930/2	0.6	0.8	1.3	2.0	2.6	4.2
TP(D) 80-120/2	1.2	1.4	1.9	2.7	3.2	4.9
TP(D) 80-140/2	0.1	0.2	0.7	1.4	1.9	3.6
TP(D) 80-180/2	0.1	0.1	0.3	1.1	1.6	3.2
TP(D) 80-210/2	0.1	0.1	0.4	1.1	1.7	3.3
TP(D) 80-240/2	0.1	0.1	0.5	1.3	1.8	3.4
TP(D) 80-250/2	0.1	0.3	0.8	1.6	2.1	3.7
TP(D) 80-330/2	0.1	0.2	0.7	1.4	2.0	3.6
TP(D) 80-400/2	0.2	0.4	0.9	1.6	2.2	3.8
TP(D) 80-520/2	0.1	0.1	0.6	1.4	1.9	3.5
TP(D) 80-570/2	0.1	0.3	0.8	1.6	2.1	3.7
TP(D) 80-700/2	0.6	0.8	1.3	2.1	2.6	4.2
TP(D) 100-120/2	1.9	2.1	2.6	3.4	3.9	5.6
TP(D) 100-160/2	0.1	0.1	0.6	1.3	1.9	3.5
TP(D) 100-200/2	0.1	0.1	0.4	1.2	1.7	3.3
TP(D) 100-240/2	0.1	0.1	0.5	1.3	1.8	3.4

Pump type	p [bar]					
50 Hz, 2-pole	**20 °C**	**60 °C**	**90 °C**	**110 °C**	**120 °C**	**140 °C**
TP(D) 100-250/2	0.6	0.8	1.3	2.0	2.5	4.2
TP(D) 100-310/2	0.6	0.8	1.3	2.0	2.6	4.2
TP(D) 100-360/2	0.6	0.8	1.3	2.0	2.5	4.2
TP(D) 100-390/2	1.0	1.2	1.7	2.4	3.0	4.6
TP(D) 100-480/2	1.5	1.7	2.2	2.9	3.5	5.1

50 Hz, 4-pole

Pump type	p [bar]					
50 Hz, 4-pole	**20 °C**	**60 °C**	**90 °C**	**110 °C**	**120 °C**	**140 °C**
TP(D) 32-30/4	0.1	0.1	0.1	0.8	1.4	3.1
TP(D) 32-40/4	0.1	0.1	0.1	0.9	1.4	3.1
TP(D) 32-60/4	0.1	0.1	0.3	1.1	1.6	3.3
TP(D) 32-80/4	0.1	0.1	0.1	0.5	1.0	2.7
TP(D) 32-100/4	0.1	0.1	0.1	0.5	1.1	2.7
TP(D) 32-120/4	0.1	0.1	0.1	0.6	1.1	2.7
TP(D) 40-30/4	0.1	0.1	0.2	0.9	1.5	3.2
TP(D) 40-60/4	0.1	0.1	0.1	0.8	1.4	3.1
TP(D) 40-90/4	0.1	0.1	0.3	1.0	1.6	3.3
TP(D) 40-100/4	0.1	0.1	0.2	0.9	1.5	3.1
TP(D) 40-130/4	0.1	0.1	0.1	0.7	1.2	2.8
TP(D) 40-160/4	0.1	0.1	0.2	0.9	1.5	3.1
TP(D) 50-30/4	0.1	0.1	0.1	0.9	1.4	3.1
TP(D) 50-60/4	0.1	0.1	0.2	0.9	1.5	3.2
TP(D) 50-90/4	0.1	0.1	0.1	0.6	1.1	2.8
TP(D) 50-110/4	0.1	0.1	0.1	0.6	1.1	2,8
TP(D) 50-130/4	0.1	0.1	0.1	0.7	1.2	2.8
TP(D) 50-160/4	0.1	0.1	0.1	0.7	1.3	2.9
TP(D) 50-190/4	0.1	0.1	0.1	0.9	1.4	3.0
TP(D) 50-230/4	0.1	0.1	0.2	1.0	1.5	3.1
TP(D) 65-30/4	0.1	0.2	0.7	1.5	2.0	3.7
TP(D) 65-60/4	0.2	0.4	0.9	1.6	2.2	3.9
TP(D) 65-90/4	0.1	0.1	0.1	0.6	1.1	2.7
TP(D) 65-110/4	0.1	0.1	0.1	0.6	1.1	2.7
TP(D) 65-130/4	0.1	0.1	0.1	0.6	1.1	2.8
TP(D) 65-150/4	0.1	0.1	0.1	0.6	1.2	2.8
TP(D) 65-170/4	0.1	0.1	0.1	0.6	1.2	2.8
TP(D) 65-240/4	0.1	0.1	0.1	0.8	1.3	2.9
TP(D) 80-30/4	0.8	1.0	1.5	2.2	2.8	4.5
TP(D) 80-60/4	0.8	1.0	1.5	2.3	2.8	4.5
TP(D) 80-70/4	0.1	0.1	0.1	0.8	1.3	2.9
TP(D) 80-90/4	0.1	0.1	0.1	0.7	1.2	2.8
TP(D) 80-110/4	0.1	0.1	0.1	0.8	1.4	3.0
TP(D) 80-150/4	0.1	0.1	0.1	0.8	1.3	2.9
TP(D) 80-170/4	0.1	0.1	0.2	1.0	1.5	3.1
TP(D) 80-240/4	0.1	0.1	0.3	1.0	1.5	3.2

Pump type	p [bar]					
50 Hz, 4-pole	**20 °C**	**60 °C**	**90 °C**	**110 °C**	**120 °C**	**140 °C**
TP(D) 80-270/4	0.1	0.1	0.2	0.9	1.5	3.1
TP(D) 80-340/4	0.1	0.1	0.3	1.1	1.6	3.2
TP(D) 100-30/4	0.8	1.0	1.5	2.2	2.8	4.5
TP(D) 100-60/4	0.6	0.8	1.3	2.0	2.6	4.3
TP(D) 100-70/4	0.1	0.1	0.1	0.8	1.3	3.0
TP(D) 100-90/4	0.1	0.1	0.1	0.9	1.4	3.0
TP(D) 100-110/4	0.1	0.1	0.2	1.0	1.5	3.1
TP(D) 100-130/4	0.1	0.1	0.6	1.3	1.9	3.5
TP(D) 100-170/4	0.3	0.5	1.0	1.7	2.3	3.9
TP(D) 100-200/4	0.1	0.1	0.5	1.2	1.8	3.4
TP(D) 100-250/4	0.1	0.2	0.7	1.4	2.0	3.6
TP(D) 100-330/4	0.3	0.5	1.0	1.7	2.3	3.9
TP(D) 100-370/4	0.3	0.5	1.0	1.7	2.3	3.9
TP(D) 100-410/4	0.5	0.7	1.2	1.9	2.5	4.1
TP 125-70/4	0.1	0.1	0.5	1.2	1.8	3.5
TP 125-90/4	0.1	0.1	0.3	1.0	1.6	3.2
TP 125-100/4	0.1	0.1	0.1	0.9	1.4	3.1
TP(D) 125-110/4	0.1	0.1	0.1	0.9	1.4	3.0
TP(D) 125-130/4	0.1	0.1	0.2	0.9	1.5	3.1
TP(D) 125-160/4	0.1	0.1	0.2	1.0	1.5	3.1
TP(D) 125-210/4	0.1	0.1	0.3	1.0	1.6	3.2
TP(D) 125-250/4	0.1	0.1	0.4	1.1	1.7	3.3
TP(D) 125-320/4	0.1	0.1	0.3	1.0	1.6	3.2
TP(D) 125-360/4	0.1	0.1	0.4	1.2	1.7	3.3
TP(D) 125-420/4	0.1	0.2	0.7	1.4	2.0	3.6
TP 150-100/4	0.1	0.2	0.7	1.4	2.0	3.6
TP(D) 150-130/4	0.1	0.1	0.4	1.1	1.6	3.3
TP 150-140/4	0.1	0.1	0.5	1.2	1.8	3.4
TP 150-150/4	0.1	0.1	0.3	1.0	1.6	3.2
TP(D) 150-160/4	0.1	0.1	0.4	1.1	1.7	3.3
TP(D) 150-200/4	0.1	0.1	0.4	1.1	1.7	3.3
TP(D) 150-220/4	0.1	0.1	0.5	1.2	1.8	3.4
TP(D) 150-250/4	0.1	0.1	0.6	1.3	1.9	3.5
TP 150-260/4	0.1	0.1	0.5	1.2	1.8	3.4
TP 150-280/4	0.1	0.3	0.8	1.5	2.1	3.7
TP 150-340/4	0.1	0.2	0.7	1.5	2.0	3.6
TP 150-390/4	0.1	0.2	0.7	1.4	2.0	3.6
TP 150-450/4	0.1	0.1	0.5	1.2	1.8	3,4

Pump type	p [bar]					
50 Hz, 4-pole	**20 °C**	**60 °C**	**90 °C**	**110 °C**	**120 °C**	**140 °C**
TP 150-520/4	0.1	0.1	1.0	1.5	1.9	3,5
TP 150-660/4	0.1	0.2	0.7	1.4	1.9	3,6
TP 150-680/4	0.1	0.2	0.7	1.4	2.0	3,6
TP 200-50/4	0.3	0.4	0.9	1.7	2.2	3.8
TP 200-70/4	0.1	0.3	0.8	1.5	2.1	3.7
TP 200-90/4	0.1	0.2	0.7	1.4	2	3.6
TP 200-130/4	0.1	0.1	0.5	1.2	1.8	3.4
TP 200-150/4	0.1	0.1	0.4	1.2	1.7	3.3
TP 200-160/4	0.3	0.5	1	1.7	2.3	3.9
TP 200-180/4	0.1	0.1	0.5	1.3	1.8	3.4
TP 200-190/4	0.2	0.4	0.9	1.6	2.2	3.8
TP 200-200/4	0.2	0.4	0.9	1.6	2.1	3.8
TP 200-220/4	0.1	0.1	0.6	1.4	1.9	3.5
TP 200-240/4	0.1	0.2	0.7	1.4	2	3.6
TP 200-250/4	0.1	0.1	0.6	1.4	1.9	3.5
TP 200-270/4	0.1	0.1	0.4	1.1	1.7	3.3
TP 200-290/4	0.1	0.1	0.6	1.3	1.9	3.5
TP 200-320/4	0.1	0.1	0.5	1.2	1.8	3.4
TP 200-330/4	0.1	0.1	0.3	1.1	1.6	3.2
TP 200-360/4	0.1	0.1	0.3	1.1	1.6	3.2
TP 200-400/4	0.1	0.1	0.3	1.0	1.6	3.2
TP 200-410/4	0.1	0.2	0.7	1.4	1.9	3.6
TP 200-470/4	0.1	0.1	0.4	1.1	1.6	3.3
TP 200-530/4	0.1	0.1	0.4	1.1	1.7	3.3
TP 200-590/4	0.1	0.2	0.7	1.4	2.0	3.6
TP 200-660/4	0.2	0.4	0.9	1.7	2.2	3.8

50 Hz, 6-pole

Pump type	p [bar]					
50 Hz, 6-pole	**20 °C**	**60 °C**	**90 °C**	**110 °C**	**120 °C**	**140 °C**
TP(D) 125-60/6	0.1	0.1	0.1	0.7	1.2	2.8
TP(D) 125-70/6	0.1	0.1	0.1	0.7	1.3	2.9
TP(D) 125-90/6	0.1	0.1	0.1	0.7	1.2	2.9
TP(D) 125-110/6	0.1	0.1	0.1	0.8	1.3	2.9
TP(D) 125-140/6	0.1	0.1	0.1	0.7	1.3	2.9
TP(D) 125-170/6	0.1	0.1	0.1	0.8	1.4	3.0
TP(D) 150-60/6	0.1	0.1	0.1	0.7	1.3	2.9
TP(D) 150-70/6	0.1	0.1	0.1	0.7	1.3	2.9
TP(D) 150-90/6	0.1	0.1	0.1	0.8	1.3	2.9
TP(D) 150-110/6	0.1	0.1	0.1	0.8	1.3	3.0

60 Hz, 2-pole

Pump type	p [bar]					
60 Hz, 2-pole	**20 °C**	**60 °C**	**90 °C**	**110 °C**	**120 °C**	**140 °C**
TP 32-80/2	0.4	0.4	0.4	1.2	1.7	3.4
TP 32-160/2	0.4	0.6	1.1	1.9	2.4	4.1
TP 32-220/2	0.7	0.9	1.4	2.2	2.7	4.4
TP 32-260/2	0.7	0.9	1.4	2.2	2.7	4.4
TP 32-330/2	0.7	0.9	1.4	2.2	2.7	4.4
TP(D) 32-300/2	0.1	0.1	0.1	0.7	1.2	2.8
TP(D) 32-360/2	0.1	0.1	0.1	0.7	1.2	2.8
TP(D) 32-450/2	0.1	0.1	0.1	0.7	1.2	2.8
TP(D) 32-550/2	0.1	0.1	0.1	0.7	1.2	2.9
TP(D) 32-680/2	0.1	0.1	0.2	0.9	1.5	3.1
TP(D) 32-820/2	0.5	0.7	1.2	1.9	2.5	4.1
TP 40-80/2	0.1	0.3	0.8	1.6	2.1	3.8
TP 40-160/2	0.1	0.2	0.7	1.5	2.0	3.7
TP 40-240/2	0.4	0.6	1.1	1.9	2.4	4.1
TP 40-270/2	0.7	0.9	1.4	2.2	2.7	4.4
TP 40-330/2	0.7	0.9	1.4	2.2	2.7	4.4
TP 40-390/2	0.7	0.9	1.4	2.2	2.7	4.4
TP(D) 40-370/2	0.1	0.1	0.1	0.8	1.3	2.9
TP(D) 40-450/2	0.1	0.1	0.1	0.8	1.4	3.0
TP(D) 40-550/2	0.1	0.1	0.1	0.8	1.4	3.0
TP(D) 40-740/2	0.1	0.1	0.3	1.0	1.6	3.2
TP(D) 40-850/2	0.1	0.1	0.6	1.3	1.9	3.5
TP(D) 40-930/2	0.3	0.5	1.0	1.7	2.3	3.9
TP 50-80/2	0.1	0.1	0.6	1.4	1.9	3.6
TP 50-160/2	0.4	0.6	1.1	1.9	2.4	4.1
TP 50-240/2	0.3	0.5	1.0	1.8	2.3	4.0
TP(D) 50-250/2	0.1	0.1	0.2	1.0	1.5	3.1
TP(D) 50-300/2	0.1	0.1	0.3	1.0	1.6	3.2
TP(D) 50-350/2	0.1	0.1	0.3	1.0	1.6	3.2
TP(D) 50-410/2	0.1	0.1	0.4	1.1	1.6	3.3
TP(D) 50-440/2	0.1	0.1	0.5	1.2	1.8	3.4
TP(D) 50-540/2	0.1	0.2	0.7	1.4	2.0	3.6
TP(D) 50-720/2	0.1	0.3	0.8	1.6	2.1	3.7
TP(D) 50-790/2	0.5	0.7	1.2	1.9	2.5	4.1
TP(D) 50-880/2	0.8	1.0	1.5	2.2	2.8	4.4
TP(D) 50-1050/2	1.1	1.3	1.8	2.5	3.1	4.7

Pump type	p [bar]					
60 Hz, 2-pole	**20 °C**	**60 °C**	**90 °C**	**110 °C**	**120 °C**	**140 °C**
TP 65-80/2	0.6	0.8	1.3	2.1	2.6	4.3
TP 65-160/2	1.1	1.3	1.8	2.6	3.1	4.8
TP 65-240/2	0.9	1.1	1.6	2.4	2.9	4.6
TP(D) 65-220/2	0.1	0.1	0.2	0.9	1.4	3.1
TP(D) 65-260/2	0.1	0.1	0.2	0.9	1.5	3.1
TP(D) 65-340/2	0.1	0.1	0.2	1.0	1.5	3.1
TP(D) 65-390/2	0.1	0.1	0.3	1.0	1.5	3.2
TP(D) 65-480/2	0.1	0.1	0.3	1.0	1.6	3.2
TP(D) 65-540/2	0.1	0.1	0.3	1.1	1.6	3.2
TP(D) 65-630/2	0.1	0.1	0.4	1.1	1.7	3.3
TP(D) 65-740/2	0.1	0.1	0.6	1.3	1.9	3.5
TP(D) 65-910/2	0.1	0.2	0.7	1.5	2.0	3.6
TP(D) 65-1050/2	0.1	0.2	0.7	1.5	2.0	3.6
TP 80-160/2	2.1	2.3	2.8	3.6	4.1	5.8
TP(D) 80-200/2	0.5	0.7	1.2	1.9	2.5	4.1
TP(D) 80-240/2	0.1	0.2	0.7	1.4	2.0	3.6
TP(D) 80-290/2	0.1	0.3	0.8	1.5	2.1	3.7
TP(D) 80-330/2	0.2	0.4	0.9	1.7	2.2	3.8
TP(D) 80-400/2	0.6	0.8	1.3	2.1	2.6	4.2
TP(D) 80-480/2	0.1	0.3	0.8	1.5	2.1	3.7
TP(D) 80-530/2	0.2	0.4	0.9	1.6	2.1	3.8
TP(D) 80-640/2	0.6	0.8	1.3	2.0	2.6	4.2
TP(D) 80-750/2	0.6	0.8	1.3	2.0	2.6	4.2
TP(D) 100-230/2	0.4	0.6	1.1	1.9	2.4	4.0
TP(D) 100-300/2	0.2	0.4	0.9	1.6	2.2	3.8
TP(D) 100-370/2	0.3	0.5	1.0	1.7	2.3	3.9
TP(D) 100-350/2	0.9	1.1	1.6	2.3	2.9	4.5
TP(D) 100-380/2	1.2	1.4	1.9	2.6	3.2	4.8
TP(D) 100-530/2	1.7	1.9	2.4	3.2	3.7	5.3
TP(D) 100-630/2	1.4	1.6	2.1	2.8	3.3	5.0
TP(D) 100-700/2	3.0	3.2	3.7	4.4	5.0	6.6

60 Hz, 4-pole

Pump type	p [bar]					
60 Hz, 4-pole	**20 °C**	**60 °C**	**90 °C**	**110 °C**	**120 °C**	**140 °C**
TP 32-40/4	0.1	0.1	0.1	0.9	1.4	3.1
TP 32-80/4	0.1	0.1	0.5	1.3	1.8	3.5
TP(D) 32-120/4	0.1	0.1	0.1	0.7	1.3	2.9
TP(D) 32-140/4	0.1	0.1	0.1	0.7	1.3	2.9
TP(D) 32-190/4	0.1	0.1	0.1	0.8	1.4	3.0
TP 40-40/4	0.1	0.1	0.3	1.1	1.6	3.3
TP 40-80/4	0.1	0.1	0.2	1.0	1.5	3.2
TP(D) 40-120/4	0.1	0.1	0.1	0.5	1.1	2.7
TP(D) 40-160/4	0.1	0.1	0.1	0.6	1.2	2.8
TP(D) 40-190/4	0.1	0.1	0.1	0.7	1.2	2.8
TP(D) 40-220/4	0.1	0.1	0.2	0.9	1.4	3.1
TP 50-40/4	0.1	0.1	0.3	1.1	1.6	3.3
TP 50-80/4	0.1	0.1	0.3	1.1	1.6	3.3
TP(D) 50-110/4	0.1	0.1	0.1	0.6	1.2	2.8
TP(D) 50-120/4	0.1	0.1	0.1	0.7	1.2	2.8
TP(D) 50-140/4	0.1	0.1	0.1	0.7	1.3	2.9
TP(D) 50-190/4	0.1	0.1	0.1	0.8	1.4	3.0
TP(D) 50-240/4	0.1	0.1	0.2	0.9	1.5	3.1
TP(D) 50-270/4	0.1	0.1	0.3	1.0	1.6	3.2
TP(D) 50-340/4	0.1	0.2	0.7	1.4	2.0	3.6
TP 65-40/4	0.4	0.6	1.1	1.9	2.4	4.1
TP 65-80/4	0.7	0.9	1.4	2.2	2.7	4.4
TP(D) 65-130/4	0.1	0.1	0.1	0.6	1.2	2.8
TP(D) 65-150/4	0.1	0.1	0.1	0.6	1.2	2.8
TP(D) 65-190/4	0.1	0.1	0.1	0.6	1.2	2.8
TP(D) 65-230/4	0.1	0.1	0.1	0.7	1.3	2.9
TP(D) 65-310/4	0.1	0.1	0.1	0.7	1.3	2.9
TP(D) 65-330/4	0.1	0.1	0.1	0.3	0.8	2.5
TP 80-40/4	1.5	1.7	2.2	3.0	3.5	5.2
TP 80-80/4	1.6	1.8	2.3	3.1	3.6	5.3
TP(D) 80-110/4	0.1	0.1	0.1	0.8	1.4	3.0
TP(D) 80-150/4	0.1	0.1	0.1	0.8	1.3	2.9
TP(D) 80-170/4	0.1	0.1	0.1	0.8	1.3	3.0
TP(D) 80-230/4	0.1	0.1	0.3	1.0	1.6	3.2
TP(D) 80-280/4	0.1	0.1	0.2	1.0	1.5	3.1
TP(D) 80-340/4	0.1	0.1	0.3	1.0	1.6	3.2

Pump type	p [bar]					
60 Hz, 4-pole	20 °C	60 °C	90 °C	110 °C	120 °C	140 °C
TP(D) 80-410/4	0.1	0.1	0.5	1.2	1.8	3.4
TP(D) 80-460/4	0.1	0.1	0.6	1.3	1.9	3.5
TP(D) 80-510/4	0.1	0.2	0.7	1.5	2.0	3.6
TP 100-40/4	1.4	1.6	2.1	2.9	3.4	5.1
TP 100-80/4	1.2	1.4	1.9	2.7	3.2	4.9
TP(D) 100-100/4	0.1	0.1	0.2	0.9	1.5	3.1
TP(D) 100-130/4	0.1	0.1	0.3	1.0	1.6	3.2
TP(D) 100-170/4	0.1	0.1	0.6	1.3	1.9	3.5
TP(D) 100-200/4	0.1	0.1	0.4	1.1	1.7	3.3
TP(D) 100-240/4	0.1	0.1	0.6	1.3	1.9	3.5
TP(D) 100-290/4	0.5	0.7	1.2	2.0	2.5	4.1
TP(D) 100-340/4	0.6	0.8	1.3	2.0	2.6	4.2
TP(D) 100-390/4	0.7	0.9	1.4	2.1	2.7	4.3
TP(D) 100-470/4	0.9	1.1	1.6	2.3	2.9	4.5
TP 125-110/4	0.1	0.3	0.8	1.5	2.1	3.7
TP(D) 125-130/4	0.1	0.1	0.3	1.0	1.6	3.2
TP 125-140/4	0.1	0.1	0.5	1.3	1.8	3.5
TP 125-150/4	0.1	0.1	0.3	1.0	1.6	3.2
TP(D) 125-160/4	0.1	0.1	0.3	1.1	1.6	3.2
TP(D) 125-210/4	0.1	0.1	0.3	1.0	1.6	3.2
TP(D) 125-260/4	0.1	0.1	0.4	1.2	1.7	3.3
TP(D) 125-320/4	0.1	0.1	0.3	1.1	1.6	3.2
TP(D) 125-360/4	0.1	0.1	0.4	1.1	1.7	3.3
TP(D) 125-430/4	0.1	0.1	0.5	1.3	1.8	3.4
TP(D) 125-490/4	0.1	0.3	0.8	1.5	2.1	3.7
TP 150-170/4	0.4	0.6	1.1	1.8	2.4	4.0
TP(D) 150-180/4	0.1	0.2	0.7	1.4	1.9	3.6
TP 150-190/4	0.1	0.2	0.7	1.4	2.0	3.6
TP(D) 150-210/4	0.1	0.2	0.7	1.4	2.0	3.6
TP 150-230/4	0.1	0.1	0.6	1.3	1.9	3.5
TP(D) 150-240/4	0.1	0.2	0.7	1.5	2.0	3.6
TP 150-250/4	0.1	0.1	0.5	1.2	1.8	3.4
TP(D) 150-300/4	0.1	0.3	0.8	1.5	2.1	3.7
TP 150-360/4	0.3	0.5	1.0	1.8	2.3	4.0
TP 150-400/4	0.1	0.1	0.1	0.8	1.4	3.1
TP 150-440/4	0.1	0.1	0.4	1.1	1.7	3.3
TP 150-480/4	0.1	0.1	0.5	1.3	1.8	3.4
TP 150-610/4	0.1	0.2	0.7	1.4	2	3.6

Pump type	p [bar]					
60 Hz, 4-pole	**20 °C**	**60 °C**	**90 °C**	**110 °C**	**120 °C**	**140 °C**
TP 150-700/4	0.1	0.3	0.8	1.5	2.1	3.7
TP 150-810/4	0.3	0.4	0.9	1.7	2.2	3.8
TP 150-960/4	0.4	0.6	1.1	1.8	2.3	4
TP 200-80/4	0.9	1.1	1.6	2.3	2.9	4.5
TP 200-110/4	0.5	0.6	1.1	1.9	2.4	4
TP 200-140/4	0.3	0.5	1	1.7	2.3	3.9
TP 200-190/4	0.2	0.4	0.9	1.6	2.2	3.8
TP 200-210/4	0.1	0.2	0.7	1.4	2	3.6
TP 200-250/4	0.9	1	1.5	2.3	2.8	4.4
TP 200-270/4	0.1	0.3	0.8	1.5	2.1	3.8
TP 200-280/4	0.7	0.9	1.4	2.1	2.7	4.3
TP 200-290/4	0.2	0.4	0.9	1.7	2.2	3.9
TP 200-320/4	0.6	0.8	1.3	2	2.6	4.2
TP 200-330/4	0.3	0.5	1.0	1.7	2.3	4.0
TP 200-360/4	0.4	0.6	1.1	1.8	2.4	4
TP 200-390/4	0.3	0.5	1	1.7	2.2	3.9
TP 200-400/4	0.1	0.1	0.6	1.3	1.9	3.6
TP 200-430/4	0.1	0.1	0.6	1.4	1.9	3.6
TP 200-440/4	0.1	0.2	0.7	1.5	2.0	3.7
TP 200-490/4	0.1	0.1	0.1	0.8	1.4	3.1
TP 200-500/4	0.2	0.4	0.9	1.6	2.2	3.9
TP 200-540/4	0.1	0.1	0.1	0.8	1.4	3.1
TP 200-600/4	0.1	0.1	0.1	0.8	1.4	3.1
TP 200-680/4	0.1	0.1	0.1	0.8	1.4	3.1
TP 200-770/4	0.1	0.2	0.7	1.4	2.0	3.7

Maximum sound pressure level

Three-phase motors [kW]	50 Hz [dB(A)]			60 Hz [dB(A)]	
	2-pole	4-pole	6-pole	2-pole	4-pole
0.12	<70	<70	-	<70	<70
0.18	<70	<70	-	<70	<70
0.25	56	41	-	<70	45
0.37	56	45	-	57	45
0.55	57	42	-	56	45
0.75	53	59.5	-	57	49
1.1	53	49.5	-	58	53
1.5	58	50	47	64	53
2.2	60	51	52	65	55
3.0	59.5	53	63	53.5	55
4.0	63	54	63	67.5	57
5.5	62	50	63	68	62
7.5	60	51	66	65	62
11.0	60	53	-	64.5	66
15.0	60	66	-	65	66
18.5	60.5	63	-	65.5	63
22.0	65.5	63	-	70.5	63
30.0	70	65	-	75	65
37.0	71	66	-	75	65
45.0	67	66	-	75	65
55.0	72	67	-	75	68
75.0	74	70	-	77	71
90.0	73	70	-	77	71
110.0	76	70	-	81	75
132.0	76	70	-	81	75
160.0	76	70	-	81	75
200.0	-	70	-	81	75
250.0	-	73	-	86	77
315.0	-	73	-	-	77
355.0	-	75	-	-	-
400.0	-	75	-	-	-
500.0	-	75	-	-	-
560.0	-	78	-	-	-
630.0	-	78	-	-	-

Pump type	Frequency [Hz]
TP 200-280/4	60
TP 200-290/4	50
TP 200-320/4	60
TP 200-360/4	60
TP 200-390/4	60

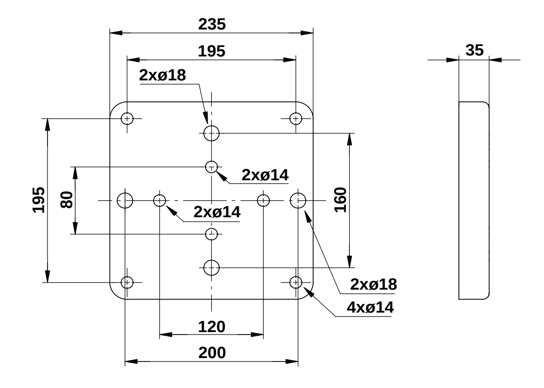


Fig. 17

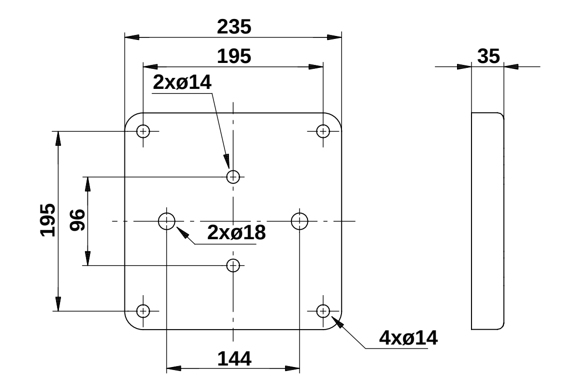


Fig. 18

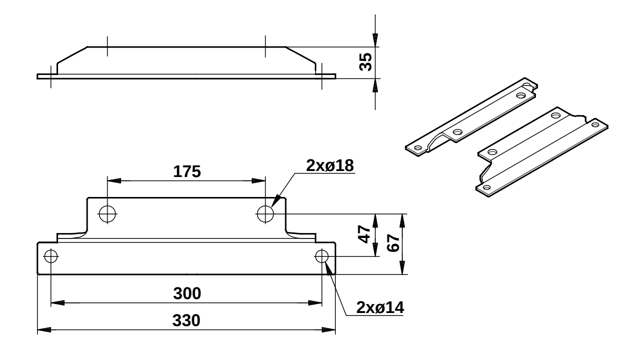


Fig. 19

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